Patent Claims

Sub A'

1. Method of structuring surfaces of micro-mechanical and/or micro-optical components and/or functional elements consisting of glass-type materials, with application of the following steps of operation:
   - providing a first substrate (2),
   - structuring at least one surface of said first substrate in order to obtain recesses (4) on the surface,
   - providing a second substrate of glass-type material (3),
   - joining said first substrate to said second substrate of glass-type material, with the structured surface of said first substrate being joined to a surface of said glass-type second substrate in an at least partly overlapping relationship,
   - annealing the substrates so bonded in such a way that said glass-type material will flow into the recesses of said structured surface of said first substrate, structuring hence that side of said second substrate which faces said first substrate, and
   - separating said second substrate from said first substrate.

2. Method of structuring surfaces of micro-mechanical and/or micro-optical components and/or functional elements consisting of glass-type materials, with application of the following steps of operation:
   - providing a first substrate (2),
   - structuring at least one surface of said first substrate in order to obtain recesses (4) on the surface,
   - providing a second substrate of glass-type material (3),
   - joining said first substrate to said second substrate of glass-type material, with the structured surface of said first substrate being joined to a surface of said glass-type second substrate in an at least partly overlapping relationship,

- annealing the substrates so bonded in such a way that said glass-type material will flow into the recesses of said structured surface of said first substrate, structuring hence that side of said second substrate which is turned away from said first substrate.

3. Method of structuring surfaces of micro-mechanical and/or micro-optical components and/or functional elements consisting of glass-type materials, with application of the following steps of operation:

- providing a first substrate (2),
- structuring at least one surface of said first substrate in order to obtain recesses (4) on the surface,
- providing a second substrate of glass-type material (3),
- joining said first substrate to said second substrate of glass-type material, with the structured surface of said substrate being joined to a surface of said glass-type second substrate in an at least partly overlapping relationship and with a gaseous medium being introduced into said recesses, which expands when heated,
- annealing the substrates so bonded in such a way that due to the expansion of said gaseous medium within said recesses in said first substrate a local displacement of said glass-type material takes place, so that the side of said second substrate will be structured, which faces said first substrate, and
- separating said second substrate from said first substrate.

4. Method according to Claim 2,
characterised in that said second substrate is separated from said first substrate.

5. Method according to Claim 1, 3 or 4,
characterised in that the separation of said second substrate from said first substrate is realised by removal of said first substrate by etching.

6. Method according to any of the Claims 1, 3 to 5,
characterised in that the separation of said second substrate from said first substrate is realised by providing a parting layer between said first and second substrates, that is applied on said structured surface while maintaining the structure prior to joining both substrates and that is configured as sacrificial layer that will be destroyed by thermal and/or chemical action and permits a separation of both substrates from each other.

7. Method according to Claim 6,
characterised in that a metal layer is employed as parting layer, whose melting point is below the melting points of said substrates.

8. Method according to Claim 6,
characterised in that an oxidisable layer is used as parting layer, which undergoes a chemical reaction when oxygen and/or thermal energy is supplied.

9. Method according to Claim 6,
characterised in that a carbon layer, a diamond layer, a diamond-type layer or SiC is used as parting layer.

10. Method according to any of the Claims 1 to 9,
characterised in that the structured surface of said first substrate presents recesses having structure widths B while said second substrate presents a thickness D, and that the following approximate relationship applies:

$$B \geq 0.1 \cdot D$$

11. Method according to any of The Claims 1 to 10,
characterised in that said first substrate is a semiconductor substrate ands/or that said glass-type material is a borosilicate glass.

12. Method according to Claim 10,
characterised in that said semiconductor substrate is a silicon substrate and/or that said borosilicate glass is Pyrex® glass.

13. Method according to any of the Claims 1 to 12,
characterised in that the step of joining said first substrate to said second substrate of glass-type material is carried out by anodic bonding.

14. Method according to any of the Claims 1, 2 or 4 to 13,
characterised in that a negative pressure prevailing throughout the joining process is preserved, after joining, in the recesses of the surface of said first substrate, between said first substrate and said second substrate of glass-type material.

15. Method according to any of the Claims 1 to 13,
characterised in that an overpressure acts upon the surface of said second substrate of glass-type material, which is turned away from said first substrate, throughout the annealing process.

16. Method according to any of the Claims 1, 2 or 4 to 15,
characterised in that the annealing process is carried out by controlling the temperature and the period in such a way that the inflow of said glass-type material into the recesses of said first substrate is stopped at a desired depth of inflow, without the in-flown glass-type material contacting the bottom of said recesses.

17. Method according to Claim 15 or 16,
characterised in that the pressure during and/or the temperature and/or the period of the annealing process are so selected that a relief moulding of the structured surface of said first substrate will be produced on the surface of said second substrate of glass-type material.

18. Method according to at least one of the Claims 1 to 17, **characterised** in that one surface of said glass substrate is planished by grinding and/or polishing after annealing or after removal of said first substrate by etching.

19. Method according to any of the Claims 1, 3 to 18, **characterised** in that a third substrate is evenly applied on a side of said second substrate, which is turned away from said first substrate, prior to the annealing process.

20. Method according to Claim 19, **characterised** in that said third substrate is a semiconductor substrate, preferably in the form of a silicon substrate.

21. Method according to Claim 19 or 20, **characterised** in that said third substrate is removed by an etching operation after the annealing process and that a planar surface is created on that side of said second substrate which is turned away from said first substrate.

22. Micro-mechanical component adapted to be manufactured in correspondence with any of the Claims 2, 4 to 16, **characterised** in that electrodes are arranged in the recesses formed in the course of the annealing process in said second substrate of glass-type material on that side which is turned away from said first substrate, and that said recesses are spanned by an electrically conductive resilient membrane.

23. Application of said micro-mechanical component according to Claim 22 as a micro-mechanical valve or relay.